

III. "Notes on the Drawing of 'Copernicus,' presented to the Royal Society by P. A. SECCHI." By JOHN PHILLIPS, Esq., F.R.S. Communicated by Col. SABINE, V.P. & Treas. R.S. Received April 9, 1856.

Of the few attempts which have been made of late years to prepare drawings*, on a large scale, of selected lunar mountains, this contribution from the Roman Observatory appears to be one of the most successful. It is on a scale of magnitude (about 10 geographical miles to one inch) such as only the larger modern telescopes can command, and characterized by such firmness of definition as to do honour alike to the maker of the instrument and to the artist engaged in the delineation. It may assist those who have not attempted, with their own hands, any drawings of this kind, and desire to form a right judgement of the value of this work of P. Secchi, if I send for comparison a drawing of Gassendi, executed from my object-glass of $6\frac{1}{4}$ inches (Cook), with a focal length of 11 feet. The drawing is on a scale of 20 geographical miles to an inch, and Gassendi thus appears of half the linear dimension of Copernicus, being really almost of the same diameter.

Placing together the two drawings, and remembering the appearance of Copernicus, as I have seen it through telescopes, some reflections arise which it may be permitted me to express, in the hope that we are now fairly entered on the long career of discoveries in the moon, to which the attention of astronomers has been of late systematically drawn by the Earl of Rosse and a Committee of the British Association.

In proportion as the power of the telescope rises, the seemingly simple 'ring mountains' of the moon exhibit as much diversity of outline and structure as the larger terrestrial volcanoes when accurately mapped. Thus while Gassendi,— 40° from the central meridian of the moon, and 17° south† of the equator,—has the obliquely elliptical contour due to a circle in that position, Copernicus, 20°

* As distinct from mere *plans*. The drawings must however be based on exact plans.

† The Poles being named after the type of Mädler's noble work, 'Der Mond.'
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from the central meridian, and 10° north of the equator, has its most conspicuous peripheral crest formed of seven principal nearly straight elements, approaching to equality in length, and meeting in points which are situated almost exactly in a circle of 24 geographical miles radius. Here is a very important partial difference, coupled with a very important general agreement.

While Gassendi, with peaks 9000 feet high, projects like a huge narrow wall into the Mare Humorum, and hangs over the interior plain in precipices as steep and many times as high as those over the Atrio del Cavallo, Copernicus, seated in the midst of broad land, on a base of 120 geographical miles, rises in many broken stages, bristling with a thousand silver-bright crests,—a perfect network of rough and complicated ground, crossed by lights and shades, which have a history of their own,—and toward the inside falls off by many irregular terraces, down to an interior plain, as if the whole area had yielded, and the surface had been formed by enormous land-slips. Four sharp notches are traced across the narrow ridge of Gassendi cutting it deeply, like the hollows left by decomposing lava dykes 500 feet broad; one deeper and broader opening unites the inner plain with the outer Mare Humorum, and one far wider opening leads to an accessory crater, over whose awful depth the cliffs, 10,000 to 12,000 ft. high, spread black shadows round some central rocks. In these particulars Copernicus offers a very different aspect. Its high crest, of 10,000 feet, is only cut through by one straight narrow meridional groove, though broken by numerous fissures in other parts, and is in all parts so irregular, partially undulated, and varied with small crateriform points, and enclosed areas, resembling craters, as to offer little analogy to any truncated cone of eruption. The highest summit, on the left hand (west) side—a huge rock—is conspicuous by its broad, deep and extended shade. What suggests a vast lava current, is equally remarkable on the northern slope. Regarding now the central plains of these mountains, we remark in each several low ridges of rather sinuous forms, and several small mounds (half a mile or more across), of which *three central digitated masses, not pierced by craters*, are the most elevated, and catch the earliest lights of morning which glance over the rocky borders of the basin. Had the drawings been executed at the

instant of sunrise on the central meridian line of the basin, these points would have stood up on the soft edge of the light and shade, as bright as the Swiss mountains at sunrise or sunset, but not like them reddened by the optical property of the atmosphere. Gassendi has *at least two* (I have somewhere a memorandum of more) small craters within the central plain. None such appear in this drawing of Copernicus. In many other lunar mountains the centre is occupied by a crater-formed hill, as Vesuvius stands within Somma; in others the hill remains a smooth rounded mass, but its crater is lost; and a further stage of decay seems to be seen in Gassendi and Copernicus, where the central mass is broken into fragments and sculptured by ramified hollows. May we ascribe these effects to the former action of a lunar atmosphere, now absorbed in the oxidated crust of the moon? If so, the lunar mountains have a history of water, as well as records of fire, and we must look on the sinuous ridges of the Mare Humorum with eyes accustomed to the gravel mounds of Norway and Ireland; study the degraded craters after the models of the Eifel; and map the 'rillen*' with reference to valleys of erosion as well as of eruption.

In questions of this kind we shall find such drawings as this of the Roman astronomer of priceless value. Studied, scrutinized, enriched with new discoveries, it may be the model for all time to come in this line of research. It may be followed by two other drawings of the same mountain,—one at the moment when the sun is on the meridian of the central hillocks, *to show the light streaks*, which hide themselves when the sun is low, and another in the clear afternoon of the lunar day (as much after midday, as this drawing was taken before noon), when every little crack and cavity becomes again distinct, *but greatly altered in aspect*, and the whole landscape changes under the eye of the observer; the plains growing grayer and softer, and revealing many minute low undulations; the hills looking more and more rugged, and burning with narrower, brighter and more angular tracts of silvery light.

* I have some curious results regarding these beautiful objects.